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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* ROBERT SHEFFIELD and EILEEN GOULET

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Appeal 2007-3676  
Application 10/667,491<sup>1</sup>  
Technology Center 1700

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Decided: February 06, 2008

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Before THOMAS A. WALTZ, CAROL A. SPIEGEL, and MARK  
NAGUMO, *Administrative Patent Judges*.

NAGUMO, *Administrative Patent Judge*.

DECISION ON APPEAL

**A. Introduction**

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<sup>1</sup> Application filed 23 September 2003. The real party in interest is listed as Nortel Networks Ltd., of Canada. (Amended Appeal Brief filed 15 September 2006 ("App. Br.") at 1.)

Appellants ("Sheffield") appeal under 35 U.S.C. § 134 from the final rejection of claims 1–6, 19, and 20. Claims 1–20 are pending. Claims 7–18 have been withdrawn from consideration. We have jurisdiction under 35 U.S.C. § 6(b). We AFFIRM-IN-PART.

The subject matter on appeal relates to a method of polishing conductive traces on circuit boards, thereby improving signal transmittance.

Claim 1 reads:

A method for improving performance of a signal transmitted via a conductive circuit trace of a circuit board, the method comprising the step of:

providing a layer of the circuit board having the conductive circuit trace on a surface thereof; and

reducing a surface roughness of at least one surface of the conductive circuit trace on the surface of the circuit board layer so as to improve performance of a signal transmitted via the conductive circuit trace.

The remaining claims depend directly from claim 1.

Claim 2 recites various methods of polishing, including mechanical polishing.

Claims 3–5 limit the surface roughness to 20, 10, and 5 micro-inches, respectively.

Claim 6 requires the surface to be the top, side, or underside of the circuit trace.

The sole rejection on appeal is that Claims 1–6, 19, and 20 are unpatentable under 35 U.S.C. § 102(b) in view of Tanaka<sup>2</sup>. (Ans. at 3ff.)<sup>3</sup>

In its principal brief, Sheffield has advanced specific arguments against the Examiner's rejections of claims 1–6, but has not made any specific arguments for the patentability of claims 19 and 20. (App. Br. at 7-11.)

**B. Findings of Fact (FF)**

The findings of fact set out throughout this Decision are supported by a preponderance of the evidence of record.

1. According to Sheffield, the self-inductance of electrical conductors forces electrons towards the surface of the conductors, in a phenomenon known as the "skin-effect." (Specification at 1:12–15.)
2. Sheffield informs us that the skin depth decreases with increasing frequency, and provides the following values:

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<sup>2</sup> Tadashi Tanaka *et al.*, *Bonded Ceramic Metal Composite Substrate, Circuit Board Constructed Therewith and Methods for Production Thereof*, U.S. Patent 4,959,507, issued 25 September 1990.

<sup>3</sup> Examiner's Answer mailed 31 October 2006.

{The following table reports skin depth in microns as a function of frequency in gigahertz}<sup>4</sup>

<u>Frequency/GHz</u>	<u>Skin depth/μm</u>
1	2.0
10	0.66
40	0.33

{The Table reports skin depth as a function of frequency.}

(Specification at 1:18–21.)

3. According to Sheffield, if the surface roughness extends to the skin depth, the mean free path of a conductive electron increases as it follows the contours of the roughness, leading to an effective increase in signal path length and an effective decrease in "signal reach and performance."

(Specification at 1:24 to 2:7.)

4. Sheffield teaches that the surface roughness may be reduced by various methods, including mechanical-, electro-, or chemical-polishing of lateral and transverse surfaces. (Specification at 2:15–20.)

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<sup>4</sup> The text in curly braces following the Table and Figures is provided to ensure compliance with section 508 of the U.S. Rehabilitation Act for publication of this Decision on the USPTO website pursuant to the Freedom of Information Act. It is not part of the Decision.



Tanaka

7. Tanaka describes ceramic circuit boards having a copper sheet bonded directly to the ceramic substrate. (Tanaka at 1:7–11.)
8. According to Tanaka, bonding a copper sheet to a ceramic substrate above the eutectic temperature of copper and oxygen ( $1065^{\circ}\text{C}$ ) but below the melting point of copper ( $1083^{\circ}\text{C}$ ) provides a strong adhesion between the sheet and the substrate and a simple structure that can be used to obtain a smaller circuit board. (Tanaka at 1:26–33.)
9. Tanaka reports that the failure of such circuit boards was traced to a decrease in the wettability of the copper by solder, leading to poor electrical connections between the copper and components. (Tanaka at 4:1–13.)
10. Tanaka describes a solution to this problem, namely polishing the surface of the copper to a median surface roughness not greater than  $3\text{ }\mu\text{m}$ , with a maximum surface roughness of not greater than  $18\text{ }\mu\text{m}$ . (Tanaka at 2:31–35; 2:68 to 3:4.)
11. Furthermore, in Tanaka's words, "[i]t is particularly preferred that the median surface roughness ( $R_a$ ) of the copper circuit sheet be not greater than  $1\text{ }\mu\text{m}$ , and that the maximum surface roughness ( $R_{max}$ ) be not greater than  $8\text{ }\mu\text{m}$ ." (Tanaka at 3:9–12.)

unit conversion factors

12. 10 micro inches is about 0.25 microns:

$$(10 \times 10^{-6} \text{ inches})(2.54 \times 10^{-2} \text{ m/inch}) = 0.25 \times 10^{-6} \text{ m.}$$

13. One micron is about 254 micro-inches:

$$(1 \times 10^{-6} \text{ m})(1 \text{ inch}/(2.54 \times 10^{-2} \text{ m})) = 254 \times 10^{-6} \text{ inches.}$$

### C. Discussion

A claim is anticipated if a prior art reference describes an embodiment within the scope of the claim, i.e., an embodiment that meets all the limitations, arranged as recited in the claims, either expressly or inherently. *Glaxo, Inc. v. Novopharm, Ltd.*, 52 F.3d 1043, 1047 (Fed. Cir. 1995) ("Invalidity on the ground of 'anticipation' requires lack of novelty of the invention as claimed. The invention must have been known to the art in the detail of the claim; that is, all of the elements and limitations of the claim must be shown in a single prior reference, arranged as in the claim.") (citations omitted). Inherency cannot be based on supposition. *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1269 (Fed. Cir. 1991). ("Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.") (citation omitted).

On appeal, the initial procedural burden is on the Appellant to demonstrate reversible error in the Examiner's rejection. Arguments not made in the principal brief on appeal are deemed to have been waived, absent a showing of good cause. 37 C.F.R. § 41.37(c)(1)(vii).

Claim 1 recites a method having two mandatory steps, namely, (1) providing a circuit board having a conductive surface trace on its surface, and (2) reducing the surface roughness enough to "improve performance of a signal transmitted via the conductive circuit trace."

Notably, claim 1 does not say what the initial surface roughness is, only that the roughness be reduced. Nor does claim 1 recite any limitations as to the frequency of the transmitted signal, or any measure of the improvement in the "performance of a signal."

The specification indicates that when the surface roughness is comparable to the skin depth, the performance of signal propagation is diminished. (FF 3; Specification at 1–2.) The specification also indicates that the skin depth of a 1 GHz signal is about 2  $\mu\text{m}$ . (FF 2; Specification at 1:19.) Thus, the "particularly preferred" median surface roughness of not greater than 1  $\mu\text{m}$  of the copper cladding (circuit trace) described by Tanaka (FF 11) is less than the skin depth for a 1 GHz signal.

If a surface is polished to a median surface roughness of about 3  $\mu\text{m}$ , then it is reasonable to presume that the initial surface roughness was significantly higher than 3  $\mu\text{m}$ . Thus, it is reasonable to presume that the circuit traces provided initially by Tanaka had a mean surface roughness greater than 3  $\mu\text{m}$ , which is greater than the 2  $\mu\text{m}$  skin depth of a 1 GHz signal. The initial surfaces presumably had decreased signal reach and performance. After polishing to the particularly preferred surface roughness of not greater than 1  $\mu\text{m}$ , the roughness of the circuit traces would be less

than the skin depth of a 1 GHz signal. In accordance with Sheffield's disclosure, such polished circuit traces would have improved signal transmission at that frequency. We therefore find that the Examiner's conclusion (Ans. at 4) that the polishing taught by Tanaka would inherently improve the performance of a signal transmitted in the copper on the ceramic circuit board, as required by claim 1, is well-supported by the evidence of record.

Sheffield's arguments that Tanaka does not disclose the intended purpose of improving signal transmission (App. Br. at 8–9) are without merit. It is well settled that "[i]nherent anticipation does not require a person of ordinary skill in the art to recognize the inherent disclosure in the prior art at the time the prior art is created." *SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1343 (Fed. Cir. 2005). As explained *supra*, the preponderance of the evidence of record indicates that polishing the copper traces to a mean roughness of about 1  $\mu\text{m}$  would have inherently reduced the transmission at frequencies of about 1 GHz. It further seems likely that improvements would have been obtained at still lower frequencies, but as the claims do not recite any limitations as to frequency, we need not consider the matter further. It suffices that Tanaka discloses polishing to a roughness within a regime disclosed by Sheffield to be technologically relevant. We note that the Examiner's reliance on the roughness taught by Tanaka is adequate only for those claims broad enough to encompass Tanaka's degree of polishing (roughness).

The Examiner's rejection of claim 1 is therefore AFFIRMED.

Claim 2 recites a number of methods of polishing the circuit traces, of which mechanical polishing, which is taught by Tanaka, is one. Accordingly, we also AFFIRM the rejection of claim 2.

Claim 6 recites that, *inter alia*, the polished circuit trace is a surface "parallel and distal to a surface of the circuit board." Such a trace corresponds to element **222A** of Figure 2, reproduced *supra* (FF 5, 6). Sheffield repeatedly denies that Tanaka describes polishing such a trace (App. Br. at 11; Reply Br.<sup>5</sup> at 6); but Sheffield does not explain why element **2b** of Tanaka Figure 1, which is described as a "terminal electrode area" (Tanaka at 3:61) is not a conductive circuit trace that has been polished in accordance with the limitations of the claims on appeal. As we find that Sheffield has failed to demonstrate reversible error by the Examiner, we AFFIRM the rejection of claim 6.

The situation is different as to claims 3–5, which recite root-mean-square surface roughnesses of 20, 10, and 5 microinches, which correspond, as Sheffield points out, to roughnesses of about 0.5  $\mu\text{m}$ , 0.25  $\mu\text{m}$ , and 0.13  $\mu\text{m}$ , respectively. (App. Br. at 11.) The Examiner merely responds that Tanaka discloses roughness values within the scope of these claims. (Ans. at 5.) The Examiner has not directed our attention to any evidence of record supporting this conclusion, nor have we found any such evidence in our review. Absent such evidence, or a compelling explanation of why

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<sup>5</sup> Reply Brief filed 29 December 2006.

surface roughnesses two- to eight-times finer than any expressly described are necessarily present, the Examiner's findings and conclusions are not sufficient to shift the burden of persuasion to Sheffield. Accordingly, we REVERSE the rejection of claims 3–5.

As Sheffield has not argued the limitations of claims 19 and 20 separately, they fall with claim 1. 37 C.F.R. § 41.37(c)(1)(vii).

**D. Summary**

In view of the preceding discussion and the Record, it is:

ORDERED that the rejection of claims 1, 2, 6, 19, and 20 under 35 U.S.C. § 102(b) in view of Tanaka is AFFIRMED;

FURTHER ORDERED that the rejection of claims 3–5 under 35 U.S.C. § 102(b) in view of Tanaka is REVERSED;

FURTHER ORDERED that no time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

**AFFIRMED-IN-PART**

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Appeal 2007-3676  
Application 10/667,491

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